

CLAIMS

1. An integrated optic switch comprising:
an optical Y-branch waveguide structure capable of guiding at least one optical mode and including:
a cladding medium;
a channel waveguide core disposed in said cladding medium and containing an input branch and first and second output branches;
a first liquid crystal material associated with the first output branch and having ordinary and isotropic refractive indices corresponding to nematic and isotropic phases of the liquid crystal material, respectively; and
a first temperature control element disposed in heat exchange relationship with the first liquid crystal material, the first temperature control element selectively adding heat to the first liquid crystal material to thereby change the phase thereof from nematic to isotropic, said change producing differential refractive index loading of the optical Y-branch waveguide such that at least a portion of optical mode light directed into one of the first and second output branches is redirected into the other of the first and second output branches.
2. The switch of Claim 1, wherein the first liquid crystal material is positively birefringent.
3. The switch of Claim 1, wherein the first liquid crystal material is negatively birefringent.
4. The switch of Claim 1, further including a second liquid crystal material associated with the second output branch.
5. The switch of Claim 4, wherein the second liquid crystal material possesses a fixed refractive index lying between the ordinary and isotropic refractive indices of the first liquid crystal material.

6. The switch of Claim 5, wherein the first liquid crystal material is in the nematic phase possessing the ordinary refractive index at ambient temperatures.

7. The switch of Claim 1, wherein the cladding medium has a refractive index lying between the ordinary and isotropic indices of the first liquid crystal material.

8. The switch of Claim 4, wherein the second liquid crystal material has ordinary and isotropic refractive indices that correspond to nematic and isotropic phases of the liquid crystal material, respectively, the switch further including a second temperature control element disposed in heat exchange relationship with the second liquid crystal material and operating to selectively add heat to the second liquid crystal material to thereby change the phase thereof from nematic to isotropic.

9. The switch of Claim 1, wherein the refractive index of the channel waveguide core is higher than the ordinary refractive index of the first liquid crystal material and higher than the isotropic refractive index of the first liquid crystal material.

10. The switch of Claim 1, wherein one of or both the isotropic and ordinary refractive indices of the first liquid crystal material are higher than the refractive index of the channel waveguide core.

11. The switch of Claim 10, wherein the first liquid crystal material is disposed in a trench having a cross-section which is smaller than a cross section of the channel waveguide core.

12. The switch of Claim 11, wherein the trench is rectangular and includes first and second sides, a top and a bottom, at least one of the first side, second side, top and bottom being provided with an alignment coating.

13. The switch of Claim 1, wherein the liquid crystal material is disposed in a trench having a first side, a second side, a top and a bottom, at least one of said first side, second side, top and bottom including an alignment coating.

14. The switch of Claim 13, wherein the alignment coating comprises SiO_x and is deposited by oblique evaporation

15. A variable optic attenuator comprising:
a cladding medium;
a channel waveguide core disposed in said cladding medium and capable of guiding at least one optical mode, the channel waveguide core containing at least one input branch and at least first and second output branches;

a first liquid crystal material associated with the first output branch and having ordinary and isotropic refractive indices corresponding to nematic and isotropic phases of the liquid crystal material, respectively; and

one or more temperature control elements disposed in heat exchange relationship with the first liquid crystal material, each temperature control element selectively adding heat to a corresponding portion of the first liquid crystal material to thereby change the phase thereof from nematic to isotropic, said change producing differential refractive index loading of the channel waveguide core such that at least a portion of optical mode light directed into one of the first and second output branches is redirected into the other of the first and second output branches.

16. The variable optic attenuator of Claim 15, wherein the first liquid crystal material is positively birefringent.

17. The variable optic attenuator of Claim 15, wherein the first liquid crystal material is negatively birefringent.

18. The variable optic attenuator of Claim 15, further including a second liquid crystal material associated with the second output branch.

19. The variable optic attenuator of Claim 18, wherein the second liquid crystal material possesses a fixed refractive index lying between the ordinary and isotropic refractive indices of the first liquid crystal material.

20. The variable optic attenuator of Claim 19, wherein the first liquid crystal material is in the nematic phase possessing the ordinary refractive index at ambient temperatures.

21. The variable optic attenuator of Claim 15, wherein the cladding medium has a refractive index lying between the ordinary and isotropic indices of the first liquid crystal material.

22. The variable optic attenuator of Claim 18, further including one or more temperature control elements disposed in heat exchange relationship with the second liquid crystal material, each temperature control element selectively adding heat to a corresponding portion of the second liquid crystal material to thereby change the phase thereof from nematic to isotropic

23. The variable optic attenuator of Claim 15, wherein the refractive index of the channel waveguide core is higher than the ordinary refractive index of the first liquid crystal material and higher than the isotropic refractive index of the first liquid crystal material.

24. The variable optic attenuator of Claim 15, wherein one of or both the isotropic and ordinary refractive indices of the first liquid crystal material are higher than the refractive index of the channel waveguide core.

25. The variable optic attenuator of Claim 18, wherein the first and second liquid crystal materials are disposed in corresponding trenches each having a first side, a second side, a top and a bottom, at least one of said first side, second side, top and bottom of each trench including an alignment coating.

26. The variable optic attenuator of Claim 25, wherein the alignment coatings comprise SiO_x deposited by oblique evaporation.

27. A liquid crystal thermo-optic element capable of being held in either of two polarization independent refractive index states, comprising:

a solid medium capable of transmitting optical radiation propagating along a given direction;

a liquid crystal material having ordinary and isotropic refractive indices corresponding, respectively, to nematic and isotropic phases, wherein, in the nematic phase, a first index of refraction is presented to optical radiation in the solid medium, and in the isotropic phase, a second index of refraction is presented to optical radiation in the solid medium; and

a temperature control element disposed in heat exchange relationship with the liquid crystal material, the temperature control element selectively causing switching in the liquid crystal material between one and the other of the nematic and isotropic phases.

28. The liquid crystal thermo-optic element of Claim 27, wherein the liquid crystal material is positively birefringent.

29. The liquid crystal thermo-optic element of Claim 27, wherein the liquid crystal material is negatively birefringent.

30. The liquid crystal thermo-optic element of Claim 27, wherein the liquid crystal material is disposed in a trench having walls, at least one of which is coated with an alignment coating.

31. The liquid crystal thermo-optic element of Claim 30, wherein the alignment coating comprises SiO_x .

32. The liquid crystal thermo-optic element of Claim 31, wherein the alignment coating is provided by oblique evaporation.

33. A method for selectively directing light in an input branch of an optical structure into one or more of multiple output branches, at least one of said output branches having associated therewith a liquid crystal material having ordinary and isotropic refractive indices corresponding, respectively, to nematic and isotropic phases, the liquid crystal material having a temperature control element in heat exchange relationship therewith, the method comprising:

launching light into the optical structure; and

using the temperature control element to change the phase of the liquid crystal material from one to the other of the nematic and isotropic phases, thereby causing at least a portion of the light launched into the optical structure to be redirected from one output branch into another.